

~~X~~ A 1508/1473  
DESCRIPTION

Of the New-Invented

*Table* AIR-PUMP:

With the manner of

Performing the most Curious Experiments upon it :

The Figures of the

*Air - Pump* Glasses,

And all the MACHINES belonging to it, being curiously Engrav'd on Copper-Plates.

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B Y

STEPHEN DAVENPORT;  
Pneumatical Instrument-Maker.

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L O N D O N,

Printed by J. LEAKE, for the AUTHOR,  
and sold at his Houfe in *High Holbourn*, and  
at Mr. WRIGHT's, Mathematical Instru-  
ment Maker, in *Fleetstreet*. 1737.





## *Advertisement.*

**A**IR-PUMPS Single and Double, with all their *Apparatus*, as hereafter describ'd, with several new Improvements.

*Engines* for condensing the Air; with *Syringes* for injecting forcibly into any Vessel; as also *Syringes* for Anatomical Injections, with all their Pipes and *Apparatus*.

*Little Pumps* for Cupping, of Brass or Silver, with *Scarificators*; that is, Instruments for ten, thirteen, or nineteen Incisions at once: Together with *Cupping-Glasses* of all Figures and Sizes.

*Cupping-Glasses* to be us'd with the Flame of Spirit of Wine, with small Lamps for that purpose.

*Blow-Pipes* of all sorts, with, or without Valves. Also *Embiers* and *Tourniquets* for Surgeons.

# Advertisement.

*Hydrostatical Ballances*, for trying the different specifick Gravities of all Fluids, Metals, Oars, &c.

All sorts of Water-Glasses, whether *Barometers*, *Thermometers*, *Marine Barometers*, *Portable Barometers*, or *Hydrometers*; that is, Instruments for determining the Moisture or Dryness of the Air at any time.

*Fountains of Glass*, or of *Japann'd Copper*, which throw up the Water to a great height in different Figures.

Machines for shewing the use of all Mechanical Powers; and Models of any Engine for raising Water, or any other use, to be made upon a sight or description of the propos'd Engine.

*Wind-Guns*, *Papin's Digesters*, *Apparatus* for performing such Feats as are pretended to be the Effects of Strength, whereby any Man may pull against two Horses, raise vast Weights, and break a strong Rope.

All these are made by *Stephen Davenport*, Pneumatical Instrument-Maker in *High Holbourn*, near the *White Hart Inn Gate*.







## *A General Description of the Air-Pump.*

**T**HE AIR-PUMP (represented in Plate 2.) consists of two Barrels or Cylinders, as is represented by *a a a a*, eight Inches in height, and an Inch and a half their Diameters within. The Suckers or *Emboli*, are rais'd and deprefs'd, by turning the Winch *b b*, backwards and forwards. The Winch is fasten'd to a Spindle, that passes through a Lantern, whose Pins perform the Office of Cogs, for its Motion ; they lay hold on the Teeth of the Racks *c c c c*, and so reciprocally, as one is deprefs'd, the other is elevated ; by which means the Valves which are made of limber Bladder, and fixt on the upper part of each *Embolus*, as well as at the Bottom of the foremention'd Cylinders, perform their Offices mutually of exhausting and discharging the same Air taken from the Recipient, or Receiver on the Plate of the Pump. And when the Recipient comes to be pretty well exhausted of its contained Air, the Pressure of the outward Air on the descending Sucker is nearly so great, that the Power required to raise the other, is very little more, than what surmounts the Friction of the moving Parts ; which renders this Pump preferable

## A General Description

ferable to any other, made of a size so convenient and portable.

The Nuts represented by *dd d*, screw down the Top of the Frame fast upon the Pillars, and likewise bind down the Frontispiece upon the Cylinders or Barrels, and hold them fast in their proper place. The Pillars are represented by *eeee e*. Now, at the Bottom of the Cylinders there is a Communication with a Brass Tube, or hollow Wire, mark'd *fff*, which goes up quite through the Plate at the Top of the Pump, mark'd *g*. The Glass Receiver, shewn by *bb*, is placed upon the Plate, in order to be exhausted. *ii* represents a Wire, which is contriv'd with a Hook in the inside of the Receiver, whereby you can lift up any thing when *in Vacuo*, without the Air's Insinuation, to what height you find necessary in several Experiments.

Upon the Plate of the Pump, is always laid a wet Leather, on which the Recipients are placed. This wet Leather prevents the Air from getting into the Glasses (whose Edges are truly ground) and is of use for that purpose, beyond any Cement whatsoever, and not only secures it from the Air's Ingress that way, but by the use of it, we can make several Experiments in the same time, they formerly could make one, and without any Daubing or Difficulty.

Another Excellency in this Pump is, the Contrivance of the Gage, denoted by *kk*; which is  
a little

## *of the Air-Pump.*

a little Receiver made for that purpose. In the Inside of it, is a Glass Tube about eight Inches long, hermetically seal'd at the upper End, and the lower End (being open) is inverted into a Cistern of Mercury. From this Plate of the Gage is also another Brass Tube, mark'd *l l l*, which passes and communicates with the former Brass Tube, or exhausting Pipe, described by *f f f*. By this Gage being so well contrived out of the way of other Experiments, you may always know exactly the Degrees of Rarification by the descending of the Quicksilver to the tenth part of an Inch.

Between the two Barrels at the lower End, is the Cock, mark'd *m*; by which you can open and let the Air return into the exhausted Vessels at pleasure: But you must always take care that this Cock is shut quite close when you exhaust the Air.

Thus far I have explain'd this light and portable Machine, with some Improvements, which I hope, will be acceptable to Gentlemen that are curious, and able to judge of the Conveniency of it; and how far it is preferable to what has been yet publish'd. And, to make it still more useful, I shall proceed to demonstrate the most curious Experiments depending upon the Pressure and Spring of the Air, &c.

Expe-

# Of the Air Pump.

The first experiment made for this purpose, in the  
table of it is a Glass Tube about eight inches  
long, and minutely sealed at the upper End, and  
the lower End (being open) is inserted into  
the mouth of Mercury. From this Tube an Air  
Glove is drawn, and another Glass Tube, and a  
small Glass and communicating with the former  
Ball, Tube of expanding Glass, directed by  
the Glass of the Glass being in well connected and  
of the same length as the former, and  
and being exactly the same of length, and  
by means of which the Air is drawn from  
the end of the Tube.



The second experiment is made in the same  
manner as the first, but the Glass Tube is  
drawn out to a length of about two feet  
and the Air is drawn from the end of the  
Tube.

The third experiment is made in the same  
manner as the first, but the Glass Tube is  
drawn out to a length of about two feet  
and the Air is drawn from the end of the  
Tube.





## Experiments on the Air-Pump,

*To shew the Expansion of the Air by its Spring or Elasticity.*

1. **T**AKE a Bladder, squeeze out the Air, so as to leave only what remains in the Folds of the Bladder; then tie it close, and seal it, so that the Air cannot escape. Lay it on the Air-Pump, and set a Receiver over it; then exhaust the Receiver, and the Air in the Bladder will expand it self, so as to blow up the Bladder. When you let in the Air, the Bladder will return to its former shape; which shews the Expansion of the Air by its Spring or Elasticity. *Plate 3. Fig. 1.*

2. To know how much the Air expands it self, Take a Glass-Bubble of about an Inch Diameter, with a Stem of about six or eight Inches; fill it almost full of Water, except a very small Bubble of Air; then inverting this Bubble or Bolt Head into a Jarr of Water, cover the whole with a Receiver, which exhaust, and the little Bubble of Air will expand it self: So that by comparing the Bigness of the said Bubble of Air, as it was at first, to its Bigness when expanded, you will know the proportion of the Expansion of the Air. *Plate 3. Fig. 2.*

B

3. Take

## 2 *Experiments upon*

3. Take an Egg, and break off evenly about a third part of the Shell at the little End, and put the Yolk and White out of the Shell, and at the bottom you'll see a small Bubble of Air, which lies between the Skin and the Shell; set the Egg (up in some little open Glass) on the Air-Pump, and put a small Receiver over it, and when you exhaust the Receiver, the Air in the Shell will expand it self, and raise up the Skin, so as to fill the Shell, and appear like a whole Egg. Or, take an Egg, and make a small Hole in the little End, and invert it in a small Glass. Set it on the Plate, and set a Receiver over it; and when you exhaust the Receiver, the Air in the Bubble will expand it self, so as to force all the Egg out of the Shell thro' the Hole in the lower End: Then let in the Air; and if the Shell be kept down, it will all return again into the Shell; which likewise shews the Expansion of the Air by its Spring. *Plate 3.*

*Fig. 3.*

4. Take the Flint Glass Bottle with the Brass Head, and put a little Mercury in the Bottom; then take the Tube which is made for that purpose, and screw it into the Hole, so that the End may almost touch the Bottom of the Bottle; then setting the Receiver with a large Tube to cover the small one over the Bottle and Tube; as you exhaust it, you'll see the Mercury rise in the Tube, according to the Expansion of the Air in the Bottle; which (when the Receiver is quite exhausted) will stand at the Height of the Mercury in the common Barometer.

*N. B.* If you compare the Height of the Mercury in the Gage under the Pump, with the Height



## *the Air-Pump.* 3

Height of the Mercury in the Tube of the Bottle aforesaid, they will appear to be of the same height ; which shews that the Spring of the Air is just equal to the Pressure of the Atmosphere.

*Plate 3. Fig. 4.*

5. Take Glass-Bubbles and hollow Glass Images, so far fill'd with Water, as to make them sink in a Jarr of Water, the whole being set under a Receiver ; and upon drawing out the Air, the Bubbles and Images will rise up to the top, but sink down again as you let in the Air.

*Plate 3. Fig. 5.*

6. The same Experiment may be made by a Bladder fill'd with Air, and just sunk with Weights.

7. Take a Bladder, and squeeze out some of the Air, so as it will go into a wooden Cylindrick Box ; then lay a Plate of Brass over the Bladder, and screw a Wire into the middle of the Plate, about nine Inches high ; lay on that Plate Lead Weights, of what weight you please, with Holes in the middle to receive the Wire : Put it on the Pump with a large Receiver over it ; then the Receiver being open at the top, lay on a wet Leather, and a Plate of Brass with a piece of hollow Wire in the middle, to receive the Wire in the other Plate, and to go also into the Holes of the Weights : Then exhaust the Receiver, and the Air in the Bladder will expand itself, and raise up the Weights, tho' you have above forty Pounds : Then let in the Air, and the Weights will come down as before. *Plate 3. Fig. 6.*

8. Take a small Tube about five Inches long, and cement it into the Brass Screw, which will fix it to the Bottle which you use for raising the



## 4 *Experiments upon*

Mercury; then tie a small Bladder upon the end of the Tube which goes into the Bottle, and seal it tight, so that the Air cannot escape any where but thro' the Tube: Squeeze the Bladder together; and having put it thro' the Screw-hole into the Bottle, screw the Brais-screw with a Leather upon it, tight into the Bottle, having first blown up the Bladder within the Bottle before you fix the Screw; so make it tight with a Key, and set the Machine on the Pump, with a Receiver over it. When you begin to exhaust, the Air in the Bottle will expand it self, and press the Bladder together; which shews how the Lungs of an Animal *in vacuo* are press'd together by the Expansion of the Air in the *Thorax*; because the Lungs having a Correspondence with the Receiver thro' the Wind pipe, have no Air in them in such a case, to keep up the Lungs against the Expansion of the Air in the Cavity of the *Thorax*, which presses against the Outside of the Lungs; as the Air in the Bottle in this Experiment causes the contained Bladder to subside *in vacuo*. Plate 3. Fig. 7.

9. Cats, or other Animals die *in vacuo*, if the Air is not let in again very soon.

10. Fishes put in a Jarr of Water under a Receiver, will (when the Receiver is exhausted) rise up to the top of the Water, without being able to go down to the bottom; because the Air in their Wind-Bladder being expanded against their Will, makes them specifically lighter than Water. Sometimes the Bladder breaks; then they will sink down to the bottom, and rise no more. N. B. Fishes, Frogs and other Animals that live in Water, will not die by exhausting the Air from the Receiver.

24. Take



## *the Air-Pump.* 5

11. Take a square Vial, and put in a Cork ; then seal it so that no Air can escape ; and put it into a Cage of Wire ; then set it on the Pump with a Receiver over it ; and when you begin to exhaust, the Air within the Bottle will expand it self so as to break it. When you have made this Experiment, wipe your Leather and the Pump-Plate, so that none of the Glafs remain ; for it may spoil another Experiment. *Plate 3. Fig. 8.*

12. The same Experiment is to be made with the Bottle and Cage under Water ; in which case the Shock will be so great, as to shake the whole Pump. *Plate 3. Fig. 9.*

### *Experiments to shew the Spring of the Air in the Pores of Bodies.*

13. TAKE an Apple, as much shrivel'd as can be had, and lay it on the Pump ; set a Receiver over it : As you exhaust the Receiver, the Apple will appear as smooth as one fresh gather'd. Let in the Air, and it will return to its former shape.

14. Take a small Jarr or Cup, and fill it almost full of small Beer ; then taste it, and set it on the Pump, and put a Receiver over it ; and when you exhaust the Receiver, the Air in Beer will expand it self, and cause the Beer to rise up in a Froth, so as to come quite over the Glafs. Then let in the Air, and taste the Beer, and you will find it quite dead.

15. Take a small Jarr or Cup, and fill it with lukewarm Water, and set it on the Pump, with a Re-

## 6 *Experiments upon*

a Receiver over it ; and when you exhaust the Receiver, the Air in the Water will expand it self, and raise large Bubbles, so that the Water which was lukewarm, will seem to boil, and diffuse its Heat, so as to warm the Receiver all over : Then let in the Air, and it will immediately cease to bubble.

16. Take a piece of Cork, and fix it to a piece of Lead, so as to poize the Cork that it will but just sink in Water ; then take a Glass-Jarr full of Water, and put in the Cork and Lead, which set on the Pump with a Receiver over it ; and when you begin to exhaust, the Air in the Pores of the Cork will expand it self, so as to swell the Cork ; which therefore becoming lighter than an equal Bulk of Water, will rise up to the Surface : Then let in the Air, and the Cork will sink to the bottom again. *Plate 3.*

*Fig. 10.*

17. Take boil'd Water ; and after having drawn as much Air out of it as can be done by the Pump, put a piece of raw Flesh into the Water, and you will find that upon pumping out the Air, that Air which was contained in the Flesh, will extricate it self in time, bubbling up through the Water.

*N. B.* There is Air in Blood, and all Animal Fluids.

*Experiments to shew the Pressure of the Air,*

18. **T**AKE a Glass open at both ends, of about two Inches Diameter and of what height you please; set it on the Pump; then lay on your Hand, so as to cover the Glass; then begin to exhaust, and you will feel the Pressure of the Air: For the Air being taken from under your hand out of the Glass, the external Air will press your Hand to the Glass; so that you can scarce move it: Upon letting in the Air, it will be loosen'd again.

N. B. The Spring of the Air in your Flesh is also shewn by this Experiment; the Flesh of the inside of your Hand swelling downward within the Exhausted Glass.

19. Take a Glass which is open at both ends; then take a Bladder, and wet it well; stretch it over the largest end of the Glass, which must be at least four Inches wide; then tye it and let it dry on; and when it is dry, set it on the Air-Pump, with the Bladder uppermost; then Exhaust the Glass, and the external Air will break the Bladder with a large Report. *Plate 3.*

*Fig. 11.*

20. Take a piece of common window-Glass, and lay it upon the mouth of a Receiver or Brass-Ferril and set it on the Air-Pump, and exhaust the Receiver or Brass Ferril, and the External Air will break the Glass all to pieces, in the same manner as the Bladder in the other Experiment.

21 Take



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21 Take a Square Bottle, and cement on a Cap of Brass, with a place for a Valve; then tie a small piece of wet Bladder over the Hole, so that the Air can come out, but cannot return the same way; then put it in the Cage of Wire, and set it on the Air-Pump with a Receiver over it; and when you exhaust the Receiver, the Air in the Bottle will come out thro' the Valve: When you have quite exhausted the Receiver, let in the Air on the sudden, which not being able to get into the Bottle, because of the Valve, it will break the Bottle all to pieces. *Plate 3. Fig. 12.*

22 Take a couple of Brass Hemispheres, and set them one upon another, with a wet Leather (which has a Hole in the middle,) in order to make them light; and having screw'd a Cock into one them, fix it to the Pump by means of a double Male Screw, always observing to have oil'd the Leather between the Screws: When you have exhausted the Hemispheres, turn the Cock to shut their Communication with the Pump: Take off the Hemispheres, and they will stick so fast as to require a great force to pull them asunder, about 140 Pounds, if their Diameter be equal to three Inches and a half, and proportionably more or less, according to their Diameters, the Weight required to draw them asunder being greater or less, just as the Square of the Diameters of the Hemispheres is greater or less than the Square of three Inches and a half; in which case the Weight is 140 Pounds.



23. The exhausted Hemispheres will fall asunder of themselves *in vacuo*, if you fix the uppermost to the Hook of the Slip-Wire before you exhaust.

In the 13<sup>th</sup> Fig. of Plate 3, you see the Hemispheres exhausted *in vacuo*. The wooden Dish made use of for the Bladder, in the 7<sup>th</sup> Experiment, being set under to receive the falling Hemisphere, lest it should damage the Glass.

24. Take the Plate of your Transfuser, (which is a Six Inch Plate;) and having by means of its Cock, fixed it to the Pump, screw a spouting Tube to the upper part of it, at the end of the Cock-screw, which comes through the Plate. Put a wet Leather upon the Plate; then set upon it the tallest Receiver you have; exhaust it, and having turn'd the Cock, take it off of the Pump. Hold this exhausted Machine over a Basin of Water; and having put the Mouth of the Cock under the Water, open the Cock, and the Atmosphere will by its pressure, force the Water up into the evacuated Receiver, making a pleasant Fountain. Plate 3. Fig. 14.

25. Having exhausted the tall Receiver above-mention'd, and taken it from the Pump, take a pretty large Glass-Fountain, or a Brass one, with its force Pipe screw'd into it, but without its Adjutage [or Spouting-pipe:] Let this Fountain be half full of Water (no Air  
C being

## 10 *Experiments upon*

being condens'd over the Water,) and having screw'd the Cock of the Plate to it, turn the Cock, and the Air in the Fountain will by its Spring press so hard upon the Water under it, as to cause it to rise through the Force pipe quite into the exhausted Receiver, spouting up in a pleasant manner as before. Plate 3. Fig. 15.

26. Take a pretty tall open Receiver ; and having set a Gallipot half full of Mercury upon the Plate of the Pump, take the four Inch Plate, and screw it to the Glass Tube that has a double Male Screw fasten'd to the end of it, so that when the Plate (with a wet Leather under it) is set upon the Receiver, the End of the Glass Tube may dip into the Mercury in the Gallipot. Then screw the little Syringe upon the upper Screw of the said Tube above the Plate and Receiver. Gently lift up the Piston of the said Syringe, and you will see the Mercury rise out of the Gallipot into the Glass Tube : Afterwards exhaust the Receiver as much as you can ; and when no Air is left in it, you may then pull the Piston off the Syringe quite up, without any Mercury going up the Glass Tube. This shews, that all the Phænomena of Suction and Pumps are not owing to an Abhorrence of a *Vacuum* in Nature ; but to the Pressure of the Air. Plate 3. Fig. 16.

27. Take

27. Take a Lamp Cupping-Glass, and set it on the Pump with a Receiver (that hath a small Hole in the Top) over it ; then exhaust the Receiver, and the Air in the Cupping-Glass will expand it self and come out ; then let in the Air on a sudden, by taking off your Finger, which was held on the Hole at the top of the Receiver, and the Cupping-Glass will be fast, and the Receiver become loosen'd. Put on the Receiver, and exhaust again, and the Cupping-Glass will be loose, and the Receiver fast as at first : But you must not set the Cupping-Glass over the Hole in the Plate ; because then you would exhaust that, and not the Receiver. This Experiment shews, that what is commonly called Suction, is only the Pressure of the Air, which fastens the Cupping-Glass, by striking against the Outside of it before it can get under it. Plate 3. Fig. 17.

28. Take two Glass Bubble Fountains (that is, Glass Bubbles of about two Inches Diameter, with a Tube so cemented in the Neck of each of them, that one End almost touches the Bubble on the Inside, and the other End without the Bubble, is almost all shut up, but a small Pin Hole) and invert the one into a little Jarr of Water, and the other into a Jarr of Mercury : Then setting all under a Receiver, upon exhausting it, the Air will by its Expansion, come out of the Fountains through the Water and Mercury. As you let in the Air again, it will force up those Fluids into  
C 2 their

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their respective Fountains ; which being afterwards set with the right End downwards in a tall Receiver, will upon exhausting it, make Jets of Water and of Mercury by the Spring of the Air above the Mercury or Water, in the Bubbles.

N. B. You must not quite exhaust the first Receiver, lest too much Mercury or Water should be forced into the Fountains. *Plate 3. Fig. 18.*

29. Take a common Barometer Tube, and fill it with Mercury, and invert it in a little Mercury in a Cup or Jarr ; then set it on the Air-Pump, and set a Receiver over it, open at the Top ; then lay a wet Leather on the Top of the Glass ; and take the large Tube mentioned in the fourth Experiment, with a Cap and a Plate cemented on the one End, hermetically sealed at the other ; and put it over the other Tube with the Mercury, so as to be tight with the Receiver: Then begin to exhaust, and the Mercury in the inner Tube will come down in the same proportion as that in the Gage rises. If your Pump be tight, you may bring it quite down, so as to be even with the Surface of the other Mercury.

Then let in the Air very gently ; for if you let it in too fast, you will endanger breaking the Tube, and spoil the Experiment.

30. Take



30. Take two Pieces of Marble, Planes of Glass, or Plates of Brass, well polish'd: Then put a little Oil between 'em to keep them from admitting the Air between them; and the lowest Marble will stick so fast to the uppermost, as to hold a considerable Weight: Then take a Receiver, open at both Ends; set it on the Air-Pump, lay a wet Leather on the Top thereof; and take the Brass Plate, with the Collar of Leathers and slip Wire, and screw on a Hook: Put the Plate upon the Top of the Glass, and hang on the Marbles, or Plates on the Hook within the Glass; then exhaust the Receiver, and they will drop a-funder. Then let down the upper Piece just upon the under, and let in the Air on a sudden; and then the Marbles, when taken taken out of the Glass, will bear more Weight than before, when you had put them together with your Hands.

The same Receiver, Plate, and Wire will serve as is used in the 22<sup>d</sup> Experiment. *Plate 3. Fig. 13.*

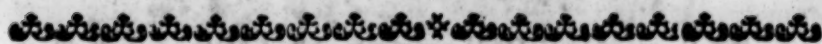
31. Take a small Syringe, with a Lead-Weight at the Bottom; then take a tall Glass, and set it on the Air-Pump, and lay a wet Leather on the Mouth thereof; then take the three Inch Plate, with the Collar of Leathers and Wire, and screw the End of the Wire into the Top of the Syringe, which put within the Glass, with the Lead weight at the bottom; then exhaust the Glass, and the Weight will  
come

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come down with the Barrel of the Syringe ; because the Air being taken out of the Receiver which press'd upon the Piston of the Syringe, the Weight becomes too heavy for the Friction of the Piston's Leather against the side of the Syringe ; and not being resisted by the Air, it must by consequence come down ; let in the Air, and the Weight rising again, will return to its former State. *Plate 3. Fig. 20.*

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*Miscel-*



*Miscellaneous Experiments.*

32. TAKE a middle siz'd Glass, wipe it well, and set it on the Plate; then begin to exhaust a little, and hold a Candle on the other side, and you will see a *Halo* about the Candle, or several Colours in the Glass, which will be seen only when the Glass is first exhausting; for when the Glass is quite exhausted, the Colours are lost; but if you let in the Air, and begin to exhaust, you will see the Colours as before, which may be repeated as often as you please. *Plate 3. Fig. 21.*

33. Take a tall Glass, set it on the Air-Pump, and lay a wet Leather on the Mouth thereof; then take a three Inch Plate, with the Collar of Leathers and Wire, and screw on the Brass Springs with the Flap at Bottom, and a Slip-Plate to open the Spring when *in vacuo*: Screw the Slip-Plate to the Wire; then put a piece of Gold, or what Metal you please, with a Feather or Bit of Paper, upon the Flap of the Springs under the Slip-Plate, and exhaust the Receiver quite. Then looking into the Receiver at Bottom, pull the Wire to open the Springs, and let Fall the Gold and Feather, which will just come at the same time to the Bottom; because the Air being taken away, which made the Resistance, all Bodies fall equally fast. *Plate 3. Fig. 22.*

34. Set

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34. Set your Bell upon the Plate of the Pump, and cover it with a middle-siz'd Receiver, then shake the Pump, and take notice of the Sound of the Bell: Exhaust the Air, and you will not hear the Sound *in vacuo*, though the Clapper is made to strike against the Side of the Bell.

35. Set a lighted Candle in your tallest Receiver, and a few Exsuctions will cause the Candle to go out. The Smoak of the Candle will then be at the Top of the Receiver; but when you have pump'd out all the Air, it will then fall down. This shews that the Smoak does not rise, because it is positively light; but only because it was specifically lighter (or less heavy) than Air.

36. A Piece of lighted Charcoal, fixt by a Wire to the Brass Hook belonging to the Collar of Leathers, so as to suspend it in the Receiver, will go out *in vacuo*.

37. When you would fire Gun-powder *in vacuo*, take a Gallypot and inverting it, set the Gun-powder Iron (that you have with the Pump) upon the Pot, having first made it red hot. Cover it with your Gun-powder Receiver (which must be first warm'd by degrees lest the Heat of the Iron should crack it) and having exhausted it, by moving the Slip Wire up and down, you will let fall a small Quantity of Gun-powder upon the Hot Iron, where it  
will



## the Air-Pump. 17

will fire, Corn by Corn. When you let in the Air again, let it be by little and little, lest you Crack the Receiver.

N. B. After every Explosion, exhaust the Receiver, because the Gun-powder generates Air, and might at last Burst the Receiver.  
*Plate 3. Fig. 23.*

38. If you would preserve Fruit, Flowers, or any thing else, *in Vacuo*, fix the Plate of your Transferer by its Hook to the Pump-Plate on which you may lay your Fruit in a Jarr: Cover the whole with a Receiver, that stands on the Transferer with a wet Leather under it. After Exhaustion, take off the Receiver, as is mention'd in the 24<sup>th</sup> Experiment, and keep it as long as you will, having Screw'd the Cock to its Wooden Foot. If you would prevent the least Air from coming in, put the whole Machine under Water, and keep it so.  
*Plate 3. Fig. 24.*

39. Soap'd Water will rise into large Bubbles *in Vacuo*; upon which you will see several Colours succeed each other; and the Skin of Water when extreamly thin, will be black.

40. With a Piece of Solid *Phosphorus* write upon a Paper; and laying it upon the Plate of the Pump with another Paper under (lest you wet the first Paper) draw out the Air, and the *Phosphorus* will brighten by degrees, and at last  
D throw

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throw up a lucid Cloud to the Top of the Receiver.

*N. B.* The Room must be dark for such kind of Experiments.

41. If you wet the Paper by Patches on which you have drawn Lines with *Phosphorus*, instead of a Cloud it will give Flashes in *Vacuo*.

42. Take the Receiver us'd, for the *Guinea* and *Feather-Experiment*, and to the Brass-Plate, us'd to cover it, screw a large Cupping-Glass with a Tube cemented to its Neck, with a fine Hole in it (so as to make a Funnel;) and having stopt the Hole of the Neck of the said Cupping-Glass with a Wooden Plug, fill it with Mercury. Under the Receiver have another tall one of an Arch'd Figure, without a Knob at Top, as in Plate 3. Fig. 5.

Then having drawn out the Air, from both Glasses, take out the Wooden Plug, and the Weight of the external Air will force the Mercury in a Shower upon the inward Glass, so as to produce a great Light in a dark Room, if the Mercury be fine, and the Weather very dry; otherwise the Experiment will not succeed.

43. Having

43. Having cemented an open Tube, ending in a Point, to a Brass Stop Cock, put it through the Brass Plate that covers an open Receiver, so that the Tube shall reach down half an Inch below the Surface of about a Pound or two of Mercury in a Glass Jarr under the Receiver. Shut the Cock ; then exhaust the Receiver, and then open the Cock ; the Air will rush in through the Mercury, so as to throw it in little Balls all over the Glass, and produce a Firey Shower, visible in a dark Room, if the Weather be dry. Plate 3. Fig. 26.

44. Having exhausted a Receiver, let in the Air again at the Top, through an Iron Tube (or Brass Tube, whose End is screw'd to an Iron one) so that it may pass through the Flame of Charcoal, before it goes into the Receiver ; and when the Receiver is full of that Air, lift up the Cover of the Receiver ; and letting down an Animal into the Glass, you will find that this infected Air will kill him immediately.

If the End of the Tube be thrust into the Hole of a Solid Piece of red hot Brass, which is not perforated quite through, the Air which must come into the Tube, will in its way, carry along with it the *Effluvia* of the Brass, which will poison the Air ; but not so much as before, an Animal being longer a dying in this, than in the least Medium.

## 20 *Experiments upon*

If a Candle be let down into the Receiver, when fill'd with Air, it will go out ; but purge the Air as far as it goes : For you may let it down the second time lower than the first, and so on 'till the whole Air be purified.

N. B. Air burn'd in going through red hot Iron or Copper, is not pernicious to a very tender Bird or any Animal that it has been try'd upon. See *Plate 3. Fig. 27.*

48. To an equal (but small) Quantity of Oil of Vitriol, Oil of Tartar *per deliquium*, and Oil of Cloves, put two or three small Pieces of *Phosphorus* ; and this Mixture will take fire in the open Air ; but the Addition of a little Common Water will put it out.

This Preparation will not only Shire but Boil up into a Flame in the exhausted Receiver.

46. If you would weigh any Quantity of Air, Take a pretty large Copper or Glass Ball, such as Fountains (by Compression of Air upon Water) are made of, and having by means of a Cock, fix'd it to the Female Screw in the Plate of your Air Pump, exhaust it ; Shut the Cock, and having taken off this exhausted Ball, hang it at one End of the Beam of a Pair of Scales ; counterpoise it at the other End ; then let in the Air by opening the  
Cock



## *the Air-Pump.* 21

Cock, and the Ball will preponderate : So much weight being requir'd to restore the *Equilibrium*, as answers to the Weight of the Air contain'd in the Ball above mention'd. *Plate 3.*

*Fig. 28.*

47. To the Slip Wire of the Collar of Leathers, at the Top of the Receiver, fix a piece of Cork, with several small Tubes going through it ; and having set a Jarr with Colour'd Water in it, under the Receiver, Pump out the Air : Then by pushing down the Slip-Wire, plunge the Ends of the small Tubes into the Colour'd Water, and it will rise as high in those Tubes as it does in open Air. See *Plate 2.* *Fig. 2.*

48. Take a Vessel of Brass like a Funnel or truncated Cone, open at both Ends, made so that the Hole at one end is not above an Inch, and half Diameter, and the other End almost four Inches. Set this truncated Cone upon the Receiver with the small Hole upwards ; and having laid a piece of flat Window Glass upon it, exhaust the Air, and the Glass will not break. Let in the Air again, and laying the same piece of Glass upon the larger Orifice of the Brass Vessel, as soon as you have drawn out the Air, it will break, which shews the Pressure of Air is Proportional to the Surface on which it presses.

The Brass truncated Cone is shewn by *Fig. 29.* in *Plate 3.*

49. Flies

## 22 *Experiments, &c.*

49. Flies will not die ; but will be unable to fly in *Vacuo*.

50. Take a piece of Wood with a little Hollow in it like a round Trencher, and weigh it ; then having laid some Mercury in the said Hollow, cover it with a Receiver ; and when you have drawn out, and again let in the Air, you will find the Wood much heavier than it was, the Air having press'd a great deal of the Mercury into the Pores of the Wood. *Plate 3. Fig. 30.*



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